Optimal location and sizing of DG Using HBMO Algorithm in Power distribution System

[1]T.C.Subramanyam, [2]S S Tulasi Ram and [3]J B V Subrahmanyam

[1]Research Scholar, JNTU College of Engineering, Hyderabad,
[2]Senior Professor, J.N.T.U.H., Hyderabad
[3]Professor and Principal, TKREC, HYD.

Abstract

Distributed Generation (DG) has gained increasing popularity as a viable element of electric power systems This paper analyzes DG placement method using HBMO and efficiency in comparison with PSO and Genetic Algorithm in order to locating and sizing of DG in distribution system. These approach for optimization in this area is tested on IEEE 33 bus test system. The objective function of this proposed method considers power losses and the voltage profile in general load condition. At first, location problem is designed as an optimization problem, and then to achieve the good results, Optimization methods are used. performance of the proposed approach in mention system is verified in MATLAB and proved that proposed method is accomplish.

Keywords: GA, PSO, voltage, real power, reactive power

1. Introduction

The particular electrical power system commonly features a generating system, a transmission system, power substations and the distribution network [1] Worldwide demand for energy is rapidly growing, threatening stability and causing concerns over the security of supply Currently, the particular electrical power market can be in the process of sizeable transform regarding design, functioning. Deployment of distributed generators (DG) within just distribution network is becoming more inviting on account of many benefits which small scale generation could possibly to enhance the electric power resources [12]. The particular distributed generation (DG) can be constituted within a new emphasis for the electrical power generation [4].

Growing of DG can be has influence in voltage profile, stability, power loses at power system both in distribution and transmission side. In order to improvement of voltage profile, addition of stability, decrease of loses power and etc, it is necessary that the installation of DGs in Distribution system become systematically.

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In order to minimization of real power osses of power system, a PSO algorithm was developed to specify the optimum placement and size of DG units. The problem was converted to an optimization program and the real power loss of the system was the only.

A new multiobjective index (IMO)-

based analytical method to find the optimal size and power factor of DG for reducing power losses and enhancing loadability.

Particle Swarm Optimization (PSO) algorithm is applied to solve the multi-objective problem. Kansal et al. [17] get recommended the use of Particle Swarm Optimization (PSO) technique to search for the best dimensions as well as optimum location for that placement of DG inside radial distribution systems pertaining to active electrical power compensation.

In this area, HBMO techniques in comparison with PSO and GA which is capable of finding optimum solution is used for locating and sizing optimally e of distributed generation in 33-bus of IEEE test system.

2. Problem Formulation

DG installation at optimal location ultimately leads to various factors such as line loss reduction, improved voltage stability, reliability and security. The main aim of the proposed method is focused on reducing the exact power loss, load balancing and voltage deviation of the given radial distribution network at the peak load condition. For obtaining the maximum benefit from the placement of DG, it is necessary to consider the impact of DG on a power system. The factors including line losses reduction and voltage profile improvement are considered in the placement and sizing of DG.

2.1 ObjectiveFunctions Formulation

The objective function combined from two components. One part is Real Power Loss (RPL) that is 70 percent of mention objective function and Voltage Profile Improvement (VPI) with 30 percent weight of objective function.

1. Real Power Loss :

Buses voltage, line currents and real power loss in system lines calculates from the output results of power-flow in this paper. For a simple two bus network, the losses that occurs in the line is given by,

$$P_e + jQ_e = (r + jx) I^2 \quad (1)$$

$$V_r \angle \delta_r = V_r \cos\delta_r + jV_r \sin\delta_r \quad (4)$$

$$[V \angle \delta - V_r \angle \delta_r]^2 = (P + jQ_e)(r + jx) \quad (5)$$

2. Voltage Profile Improvement (VPI):

One of the avails of optimizes location and size of the DG is the improvement in voltage profile. This index penalizes the size-location pair which gives higher voltage deviations from the nominal value (Vnom). The required voltage deviation equation is described in the following equation (7).

$$f_2 = \sum_{i=1}^{N} (V_i - V_{rated})^2 \quad (7)$$

Where, V_{rated} is the specified voltage; V_i the voltage at bus and N the number of buses.

The Multi Objective Function (MOF) in this paper in order to achieve the performance

$$MOF = \sigma_1 IVD + \sigma_2 ILP$$

Constrains Formulation:

The multi objective function (11) is minimized subjected to various operational constraints to satisfy the electrical requirements for distribution network. These constraints are the following.

1) Power-Conservation Limits.

The algebraic sum of all incoming and outgoing power including line losses over the whole distribution network and power generated from DG unit should be equal to zero.

2) Voltage Limits.

The voltage limits depend on the voltage regulation limits should be satisfied.

$$V_i^{min} \le V_i \le V_i^{max} \quad (10)$$

This paper employs Particle Swarm Optimization technique to solve the above optimization problem and search for optimal or near optimal set of problem. Typical ranges of the optimized parameters are [0.01 100] MW for PDG and [0.95-1.05] for voltage of buses.

3. Honey Bee Mating Optimization

The honey bee is a social insect that

Where α is a factor and γ is the amount of energy reduction after each transition. Also, Algorithm and computational flowchart of HBMO method to optimize the PEM controller parameters is presented in Figure 1.

calculation of distribution systems for DG size and location is given by:

Where σ_1 and σ_2 consider in this paper 0.6 and

can survive only as a member of a community, or colony. The colony inhabits an enclosed cavity. A colony of honey bees consist of several hundred drones. The HBMO Algorithm is the combination of several different methods corresponded to a different phase of the mating process of the queen. In the marriage process, the queen(s) mate during their mating flights far from the nest. A mating flight starts with a dance performed by the queen who then starts a mating flight during which the drones follow the queen and mate with her in the air. In each mating, sperm reaches the spermatheca and accumulates there to form the genetic pool of the colony. When the queen mates successfully, the genotype of the drone is stored. At the start of the flight, the queen is initialized with some energy content and returns to her nest when her energy is within some threshold from zero or when her spermatheca is full. In developing the algorithm, the functionality of workers is restricted to brood care, and therefore, each worker may be represented as a heuristic which acts to improve and/or take care of a set of broods. A drone mates with a queen probabilistically using an annealing function as [10].)

Where Prob (Q, D) is the probability of adding the sperm of drone D to the spermatheca of queen Q (that is, the probability of a successful mating); Δ (f) is the absolute difference between the fitness of D (i.e., f (D)) and the fitness of Q (i.e., f (Q)); and S (t) is the speed of the queen at time t. After each transition in space, the queen's speed, S(t), and energy, E(t), decay using the following equations.

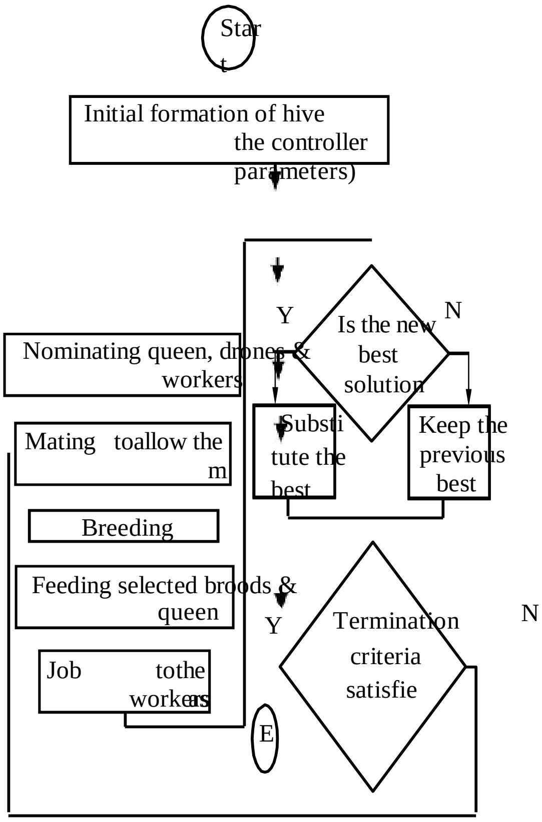

Figure 1. HBMO flowchart Figure 2 . IEEE 33 bus study system with tie lines

4. Numerical Results and Discussion

In the case study presented in this section, we investigate how optimization algorithms affects DG placement, system power loss reduction and voltage profile enhancement. The placement of two DGs and Three DGs are considered using various algorithms. To demonstrate the utility of the placement algorithms, a 33-bus test system that present and shown in Figure 2 is considered and the system details are given in Table 1.

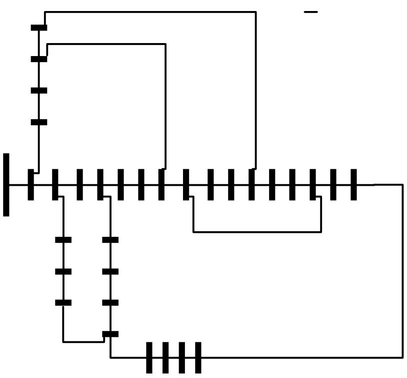

Table 1. Lines, active and reactive power details in study system

Branch no m.	Sen Node	Rec. node	P of Rec . node KW	Q of Rec . node KVAr	Resistance ohms	Reactance ohms
1	1	2	100	60	0.0946	0.0470
2	2	3	90	40	0.4945	0.251 1
3	3	4	120	80	0.3690	0.1 864
4	4	5	60	30	0.3811	0.1941
5	5	6	60	20	0.8190	0.7070
6	6	7	200	108	0.1872	0.6188
7	7	8	200	100	1.7114	1.2351
8	8	9	60	20	1.0300	0.7400
9	9	10	60	20	1.0440	0.7400
10	10	11	45	30	0.1966	0.0650
11	11	12	60	35	0.3746	0.1238
12	12	13	60	37	1.4680	1.1550
13	13	14	120	80	0.5416	0.7129
14	14	15	60	10	0.5910	0.5260
15	15	16	60	20	0.7463	0.5450
16	16	17	60	40	1.2890	1.7210
17	17	18	90	40	0.7320	0.5740
18	18	19	90	40	0.1640	0.1565
19	19	20	90	40	1.5042	1.3545
20	20	21	90	40	0.4095	0.4784
21	21	22	90	40	0.7089	0.9373
22	22	23	90	50	0.4512	0.3083
23	23	24	420	250	0.8980	0.7091
24	24	25	420	245	0.8960	0.7011
25	25	26	60	25	0.2030	0.1034
26	26	27	60	25	0.2842	0.1447
27	27	28	60	20	1.0590	0.9345
28	28	29	120	70	0.8042	0.7006
29	29	30	200	600	0.5084	0.2585
30	3	3	150	70	0.97	0.9630

	0	1			44	
31	3	3	210	100	0.31	0.3619
	1	2			05	
32	3	3	60	40	0.34	0.5345
	2	3			10	
33*	2	8			2.00	2.0000
	1				00	
34*	2	12			2.00	2.0000
	2				00	
35*	9	15			2.00	2.0000
					00	
36*	2	29			0.50	0.5000
	5				00	
37*	3	18			0.50	0.5000
	3				00	

We assume that two DG units that size of them between 25KW-10MW are considered to locate in 33-bus tie line system. Results of this case using various algorithms present in table (2)

In 33 bus IEEE system without any DG, the network loss is 70.2kW and the minimum voltage in bus 14 is 0.974 pu. As can be seen, that is obvious the two DG placement results in line power losses and voltage profile is better than without DG in study system. After locatong the DG , the total of system is achieved 34.8, 35 and 36.8 kW using HBMO, PSO and GA algorithm, respectively. Voltage profile for all of mentioned algorithms and without any DG are presented in Fig 3. From of this figure, it can be say that the placement of DGs in system improved the all of bus voltage. In comparison with without DG condition, the voltage of three placement cases is very better.

Table 2. Results of sizing and sitting with various algorithm

Optimization algorithm	DG Size	DG Site	Network Loss
Without DG	------	----	70.2KW
HBMO	1584.1 1627.3	15 25	34.8KW
PSO	1626.6 1606.2	14 25	35KW
Genetic Algorithm	1548.0 1798.1	25 9	36.8KW

In three algorithms, using the HBMO the minimum value of bus voltage is achieved 0.9925 pu. Using the PSO and GA this value is achieved 0.991 pu.

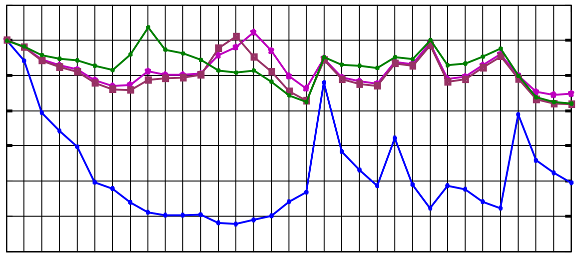

Figure 3. voltage profile of study system with various placement results

5. Conclusion

In this area, a various methods based on HBMO, PSO and GA in order to Multiobjective optimization analysis, including two DG units, for size-site planning of DG in distribution power system was presented. In solving this problem, at first problem was formated in the form of the optimization problem which its objective function was defined and written in time domain and then the problem has been solved using three methods. The proposed optimization algorithm was applied to the 33-bus test system with tie lines. Using the results, the efficiency of these algorithms for improvement of voltage profile and reduction of power losses in study system is analyzed. The results of this methods are shown the effeciency of HBMO algorithm for mentioned test system.

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